

INDICATION OF THE HIGH MASS-TRANSFER RATIO IN S-TYPE SYMBIOTIC BINARIES

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Abstract. By modelling H⁰ column densities in eclipsing S-type symbiotic stars EG And and SY Mus, we derived the wind velocity profile and the corresponding mass-loss rate from their giants. Our analysis revealed a strong enhancement of the wind at the orbital plane.

1 Introduction

The wind mass transfer in symbiotic binaries is connected with the long-standing problem of a large luminosity of their hot components and an inefficient wind mass transfer from their red giants in the canonical Bondi-Hoyle accretion mechanism. Investigation of the giant wind properties can aid us in a better understanding of the wind mass-transfer mode in these widest interacting binaries.

2 Method and results

We investigated a distribution of the neutral hydrogen (H⁰) from the wind of giants in eclipsing S-type symbiotic stars EG And and SY Mus. For this purpose, we used far-UV spectra measured by the IUE and HST satellites, available from their archives. By modelling the Rayleigh attenuation of the continuum around the Ly- α line (Fig. 1, left), we obtained H⁰ column densities, $n_{\text{H}^0}^{\text{obs}}$, at different orbital phases (Fig. 1, right). Some values were supplemented from the literature. Further, we modelled $n_{\text{H}^0}^{\text{obs}}$ values taking into account ionization of the giant's wind (Seaquist *et al.* 1984) and used the inversion method for the column density function according to Knill *et al.* (1993) to derive the wind velocity profile (WVP). In this way we derived a relation for the total H⁰ column density, $\tilde{n}_{\text{H}}(b)$, as a function of the orbital phase (or the impact parameter b), and the WVP, $v(r)$, in the form,

$$\tilde{n}_{\text{H}}(b) = \frac{n_1}{b} + \frac{n_K}{b^K}, \quad v(r) = \frac{v_\infty}{1 + \xi r^{1-K}}, \quad (2.1)$$

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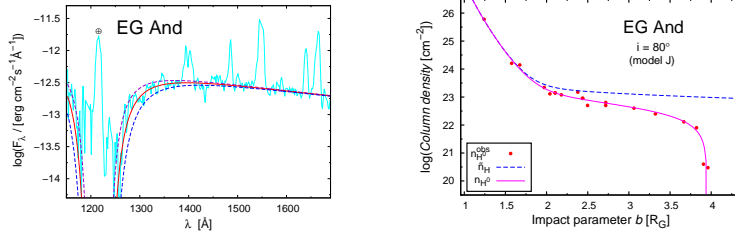


Fig. 1. Left: Far-UV spectrum of EG And attenuated with $n_{\text{H}^0}^{\text{obs}} = (1.5 + 0.7 / -0.5) \times 10^{23} \text{cm}^{-2}$. Right: $n_{\text{H}^0}^{\text{obs}}$ values (circles) and our models (solid and dashed line).

where n_1 , n_K and K are fitting parameters, v_∞ is the terminal velocity of the wind, $\xi = (n_K \lambda_1) / (n_1 \lambda_K)$, λ_1 and λ_K are the eigenvalues of the Abel operator (see Knill *et al.* 1993). Example of a model and its parameters for EG And are in Fig. 1 and Table 1. Corresponding values of the spherical equivalent of the mass-loss rates, $\dot{M}_{\text{sp}} \approx 10^{-6} M_\odot \text{yr}^{-1}$, are a factor of ≈ 10 larger than total rates measured by independent methods ($\approx 10^{-7} M_\odot \text{yr}^{-1}$, e.g. Seaquist *et al.* 1993). This findings suggests that the wind from giants in S-type symbiotic stars is focused towards the binary orbital plane, because both systems are eclipsing, and thus our $n_{\text{H}^0}^{\text{obs}}$ values are given by densities at the near-orbital-plane region. According to the model of Nagae *et al.* (2004), our WVPs correspond to the mass-accretion ratio 15 – 18%.

Table 1. Resulting parameters, n_1 , n_K , K and X^{H^+} ; X^{H^+} is the ionization parameter.

object	i	$n_1 [10^{23}]$	n_K	K	X^{H^+}	$\dot{M}_{\text{sp}} [M_\odot \text{yr}^{-1}]$
EG And	80°	3.87	1.15×10^{27}	14	1.85	1.8×10^{-6}

3 Conclusions

By modelling the H^0 column densities around giants in eclipsing S-type symbiotic stars EG And and SY Mus, we determined the WVP and the corresponding \dot{M}_{sp} from their giants. Our analysis revealed that \dot{M}_{sp} are a factor of ≈ 10 higher than observed total \dot{M} . This suggests that the giant’s wind is significantly enhanced at the orbital plane, where can be effectively accreted onto the hot component. In this way, we indicated a high mass-transfer ratio in S-type symbiotic binaries.

References

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